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(54) **Fastener and panel assembly and method of making same**

Befestigungselement zum Zusammenbau von Platten sowie Herstellungsverfahren

Dispositif d'assemblage et de fixation de panneaux et son procédé de fabrication

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Description

[0001] The invention relates to a method of riveting a plurality of plastically deformable panels together in face-to-face relationship and of attaching a fastener to said panels, and to an improved fastener and panel assembly, wherein the fastener is permanently attached to a plurality of panels retained in face-to-face relation and the fastener may then be utilised to retain a structural element to the panel assembly. The method of this invention is particularly adapted for mass production applications, such as automotive applications, requiring intimate contact between the panels, which may be relatively heavy gauge steel panels, and the fastener may be self-piercing and clinching.

[0002] Self-attaching fasteners are now used extensively in mass production applications by the automotive appliance industries, for example, to permanently attach a structural element to a panel, such as a metal bracket, frame member or body panel. US-A-2,707,322 and US-A-3,648,747 disclose pierce nuts which have been widely adapted by the automotive industry, wherein the pierce nut is permanently attached to a metal panel in a die press, and the press may also be utilised to form the metal panel into a contoured shape. A pierce nut is permanently installed in the metal panel with each stroke of the press, wherein the pilot portion of the pierce nut pierces a slug from the panel and the panel is then deformed into grooves provided in the body portion of the nut. US-A-4,555,838 and US-A-4,610,072 disclose improved fastening systems for permanently installing male and female fasteners in a panel in mass production applications. A fastener in such fastening systems include a tubular or annular barrel portion which is riveted to the panel during the installation. The tubular barrel portion may be utilised to pierce a slug from the panel, which is received in the tubular barrel portion as disclosed in US-A-4,555,838, or a punch may be utilised to pre-pierce or simultaneously pierce the panel as disclosed, for example, in US-A-4,711,021, US-A-4,831,598 and US-A-4,713,872. All the above prior art documents are concerned with the fixation of a fastener to a single panel.

[0003] In recent years, the automotive industry, for example, has substantially reduced the weight of vehicles to improve fuel efficiency and the thickness of the metal panels and plates utilised by the industry has also been reduced. These fastener systems were designed, in part, to attach a fastener to thinner panels, including steel panels having a thickness of about 0.76 mm (0.030 inches).

[0004] There is a need, however, for a fastener system for heavier gauge panels and fastener systems having improved torque resistance. The fastener system disclosed in US-A-5,335,411 may be utilised with a broader range of panel thickness, including steel panels ranging in thickness from 0.75 mm to 4 mm.

[0005] There is also a need for a fastener system which attaches a plurality of panels in face-to-face relation which has not been met by the fastener systems disclosed in the above-referenced patents. At present, steel panel assemblies are typically attached by spot welding. A weld fastener is attached to one of the panels, forming a fastener and panel assembly. For example, the axle housing of an automobile may be attached to a U-shaped frame assembly which comprises two nested steel panels which are spot welded together. Holes are formed in the panels where the fasteners are required to attach the axle assembly to the frame and the fasteners are welded to the inside panel aligned with the holes. The frame assembly may then be dip coated with wax to reduce corrosion; however, the liquid wax wicks between the panels because the panels are not in intimate contact. When bolts are threaded into the weld nuts attached to one of the panels, the panels are compressed and the wax is extruded from between the panels. However, because the was is viscous, it is extruded slowly and the bolts must be tightened several times to ensure a tight connection. Further, the welded fasteners may also be subject to failure under high torque loads.

[0006] According to the present invention, there is provided a method of riveting a plurality of plastically deformable panels together in face-to-face relationship in accordance with claim 1 and a fastener and panel assembly in accordance with claim 14.

[0007] The fastener and panel assembly of this invention may be utilised to attach a plurality of panels in intimate matting face-to-face relation such that wax, for example, will not wick between the panels and the fastener provides improved torque resistance. Further, the fastener may be self-piercing, such that the fastener may be utilised in mass production applications in a die press. The method of this invention may also be used to interconnect two or more panels together in a conventional die press and provides improved pull-out and push-through resistance. Thus, the fastener and panel assembly of this invention provides important advantages over the prior art and fulfills a need which is not met by the present fastener assemblies.

[0008] The fastener and panel assembly of this invention includes a plurality of plastically deformable panels permanently retained in face-to-face relation and a fastener for attachment of other elements to the panel assembly. The fastener includes a barrel portion, preferably a tubular portion, which may be utilized to pierce an opening in the first panel, as described below in regard to the method of this invention. The fastener further includes a flange portion which extends radially from the barrel portion, generally perpendicular to the barrel portion, and a fastener portion generally opposite the barrel portion. Where the fastener is a female or nut-type fastener, the fastener may include a threaded bore which is coaxially aligned with the barrel portion or a smooth bore which receives a self-tapping or thread-rolling screw or bolt. Where the fastener is a male fastener,

such as a stud or bolt fastener, the fastener portion extends from the flange portion coaxially aligned with the barrel portion. In the most preferred embodiments, the flange portion includes a groove adjacent the barrel portion which surrounds the barrel portion to provide a mechanical interlock between the fastener and the first panel.

[0009] The fastener and panel assembly of this invention further includes a first panel having an opening which receives the fastener barrel portion and the first panel bears against the fastener flange portion and is preferably deformed in the flange portion groove to retain the fastener to the first panel. In the most preferred embodiment, the outer surface of the barrel portion includes a radial annular rib spaced from the free end of the barrel portion which bears against the first panel, entrapping the first panel in the annular groove in the flange portion. As described below in regard to the method of this invention, the annular rib is preferably deformed from the barrel portion as the fastener is affixed to the first panel.

[0010] The fastener and panel assembly further includes a second panel having an opening which receives the barrel portion therethrough and the free end of the barrel portion is deformed radially outwardly over the second panel, permanently attaching the panels together in face-to-face relation with the fastener portion extending from the first panel to attach another element to the panel assembly, as described above. In the most preferred embodiment, the first panel includes an annular groove or recess which surrounds the barrel portion which is formed into the first panel as the panel is deformed into the annular groove of the flange portion of the fastener. The second and further panels are then deformed into the annular recess in the first panel, forming an intimate face-to-face contact between the panels secured by the fastener. The free end of the barrel portion is preferably deformed radially outwardly into an arcuate hook-shape over an edge of the second panel surrounding the second panel opening and the second panel is deformed radially inwardly against the barrel portion forming a very secure mechanical interlock between the fastener and the second panel.

[0011] The preferred method of attaching a plurality of panels together in face-to-face relation with a fastener of this invention includes locating a fastener opposite a first panel with the free end of the barrel portion facing the first panel. The method then includes driving the fastener barrel portion free end against the first panel, piercing an opening in the first panel, then driving the fastener barrel portion through the opening in the first panel and securing the fastener to the first panel by a mechanical interlock. The method further includes forming an opening in a second panel configured to receive the barrel portion of the fastener, then locating the second panel on the first panel in face-to-face relation with the fastener barrel portion extending substantially through the second panel opening and finally deforming the fastener barrel portion radially outwardly to securely rivet the second panel to the first panel and mechanically affix the fastener to the panel assembly with the fastener extending from the first panel to attach further elements to the panel assembly. Two or more panels may be attached to the first panel by the method of this invention.

[0012] Reference should be made here to US-A-5,365,654, which is also concerned with securing a plurality of panels together in face-to-face relation using a fastener element which is, however, not additionally used for connection to a further fastener element. Moreover, in US-A-5,365,654 the panels are joined to the fastener element in a single securing operation which is not always desirable. For example, in many applications, it is preferable to securely retain the fastener to the first panel prior to receipt and securement of the second and further panels. In a mass production application, for example, the fastener may be attached to the first panel at one location, such as where the first panel is deformed into a configured shape. The fastener and first panel assembly is then moved to a second station where the fastener and first panel assembly is attached to a second panel. In mass production applications, the fastener and first panel assembly may be loaded into a bin with other assemblies and the fastener may become dislodged from the first panel unless the fastener is securely retained to the first panel. Further, as described above, the fastener may be subjected to torque loads in the panel assembly and thus the fastener must be provided with anti-rotation means in such applications. Thus, as described above, the fastener preferably includes an annular groove in the flange portion adjacent the barrel portion which surrounds the barrel portion. In the most preferred embodiment, the groove is generally V-shaped, extending radially inwardly toward the barrel portion and the groove includes a plurality of radial ribs which generally bridge the V-shaped groove. The method of this invention then includes deforming the first panel adjacent the panel opening into the annular groove in the flange portion forming a mechanical interlock between the first panel and the fastener, wherein the ribs prevent rotation of the fastener in the panel assembly. Further, an annular recess is preferably deformed in the first panel as the panel is deformed into the annular groove in the barrel portion and the second panel is deformed into the annular recess in the first panel, forming an intimate face-to-face relation between the first and second panels, preventing entry of foreign material between the panels, including the wax coating which may be applied to the panel assembly.

[0013] In a preferred method of this invention, the second panel is deformed in the assembly process, preferably as the opening is formed in the second panel, by forming a generally conical or frusto-conical lip surrounding the opening in the second panel having a free circular edge spaced from the plane of the second panel. The method then includes locating the second panel

on the first panel with the frusto-conical lip bearing against the first panel. The method then includes flattening the conical lip radially inwardly against the barrel portion of the fastener as the free end of the barrel portion is deformed radially outwardly to permanently secure the panel assembly. If additional panels are attached over the second panel, the additional panels are preferably deformed to provide a frusto-conical lip surrounding the panel opening, as described.

[0014] Where two or more panels are attached by the fastener, the panels may be pierced and formed simultaneously. The panels are preferably retained in face-to-face relation, such as by spot welding, then pierced and deformed adjacent the pierced opening to form a frusto-conical lip surrounding the opening in both panels. The fastener barrel portion is then located in the pierced panel opening with the frusto-conical lip facing the radial flange. The frusto-conical lip is then driven against the first panel, flattening the conical lip of the panels, deforming the lips radially inwardly against the exterior surface of the barrel and the free end of the barrel is simultaneously deformed radially outwardly over the last panel, forming a secure mechanical interlock between the fastener and panel assembly.

[0015] The barrel portion of the most preferred embodiment of the fastener includes a first portion having a diameter adjacent the free end of the barrel portion which is less than a second larger diameter portion adjacent the flange portion, defining a radial shoulder at the junction between the first and second portions. The antirotation ribs may extend from the groove into the second larger diameter portion, providing improved torque resistance for the fastener and panel assembly. The method of this invention then includes driving the barrel portion through the panel opening to receive the second larger diameter portion of the barrel portion in the panel opening. Where the panel opening is pierced by the barrel portion, the barrel portion preferably includes an outer edge which pierces an opening in the panel having a diameter generally equal to the first smaller diameter portion of the barrel portion. Where the panel is prepierced, the diameter of the panel opening is preferably less than the diameter of the second larger portion of the barrel portion. The radial shoulder is then deformed radially outwardly forming a radial rib against the first panel, entrapping the first panel in the groove or recess in the flange portion. Thus, the fastener is securely retained on the first panel prior to receipt of the second panel, which is desirable in mass production applications for the reasons set forth above.

[0016] The fastener and panel assembly and method of this invention will be more fully understood from the following description of the preferred embodiments, appended claims and drawings, a brief description of which is set forth below.

Figure 1 is an end perspective view of an improved female fastener which may be utilized in the fastener and panel assembly and method of this invention;

Figure 2 is a side partially cross-sectioned view of the female fastener shown in Figure 1;

Figure 3 is a side partially cross-sectioned view of the fastener shown in Figures 1 and 2 as the fastener is being installed in a first panel in a die press;

Figure 4 is a side partially cross-sectioned view of the fastener and first panel assembly in a die press, similar to Figure 3, after installation of the fastener in a first panel;

Figure 5 is a side partially cross-sectioned side view of a die press assembly which may be used to form the second panel;

Figure 6 is an enlarged side partially cross-sectioned view of the die press shown in Figure 5 following piercing and forming of the second panel;

Figure 7 is a partial side cross-sectional view of the opening formed in the second panel;

Figure 8 is an exploded partially cross-sectioned side view of the first panel and fastener assembly show in Figure 4 in a die assembly attaching a second panel formed as shown in Figures 5 and 6;

Figure 9 is a partially cross-sectioned side view similar to Figure 8 following installation of the fastener to the second panel;

Figure 10 is a side view of a typical installation of the fastener and panel assembly of this invention during attachment of a further element; and

Figure 11 is an enlarged side partially cross-sectioned view of the fastener and panel assembly shown in Figure 10;

Figure 12 is a side, partially cross-sectioned view, similar to Figure 6, illustrating piercing and forming a plurality of panels in nested relation;

Figure 13 is an enlarged view of the formed opening in the panels shown in Figure 12;

Figure 14 is a side, partially cross-sectioned view, of a fastener and panel assembly, wherein the panels formed as shown in Figures 12 and 13 are attached to the fastener and the first panel assembly; and

Figure 15 is a drawing similar to Figure 2 in the right-hand half but showing an alternative design of the anti-rotation means in the left-hand half in the form of knurled splines or axial ribs.

[0017] Figures 1 and 2 illustrate a preferred embodiment of a fastener 20 which may be utilized in the fastener and panel assembly and method of installation of this invention in the form of a female fastener. The fastener 20 includes a barrel portion 22, which is preferably annular or tubular, a radial flange portion 24 adjacent the barrel portion 22, which extends generally perpendicular to the barrel portion, and a fastener portion 26 generally opposite the barrel portion 22. In a preferred embodiment, the free end 28 of the barrel portion is self-piercing, which is particularly advantageous in many mass production applications. In this preferred embod-

iment of the method of this invention, the radially outer edge 30 of the free end 28 of the barrel portion 22 is relatively sharp, as best shown in Figure 2, to pierce a slug from the panel leaving an opening therein having an inside diameter generally equal to the outside diameter 32 of the free end of the barrel portion as described below in regard to the method of this invention. Further, the outside diameter of the barrel portion at 32 adjacent the free end 28 is smaller than the outside diameter at 34 adjacent the flange portion 24 defining a radial shoulder 36, as best shown in Figure 1. Thus, as the barrel portion is driven into the opening pierced by the smaller diameter barrel portion 32 the larger diameter portion 34 provides an interference fit with the hole in the first panel, as described below.

[0018] The flange portion 24 includes an outer annular panel bearing surface 38 and an annular groove 40 adjacent the barrel portion 22 and surrounding the barrel portion. As best shown in Figure 2, the groove 40 is V-shaped having a bottom wall extending radially into the bearing surface 38 of the flange portion toward the barrel portion and an inside wall coincident with the outer surface 34 of the barrel portion. In the preferred embodiment, the groove includes a plurality of spaced radial ribs 42 which extend from the groove into the surface 34 of the larger diameter barrel portion, providing excellent torque resistance of the fastener in the panel assembly.

[0019] As described above, the disclosed embodiment of the fastener 20 is a female fastener having an internally threaded bore 44 which is preferably coaxially aligned with the internal surface 46 of the barrel portion. Where the female fastener is used with a self-tapping or thread rolling screw or bolt, the bore 44 will be unthreaded. Further, as described above, the fastener 20 may be a male fastener, wherein the fastener portion 26 may be solid and the free end may be threaded, for example, to provide a bolt fastener in the fastener and panel assembly of this invention. In the disclosed embodiment, the female fastener portion 26 includes a tubular portion 48 and a sealing cap or slug 50 which is retained in a slot 52 in the free end 54 of the tubular portion 48 and the free end 54 is deformed or coined over the cap 52 as shown in Figure 2. A sealing cap 50 is provided in applications where foreign material must be kept out of the fastener assembly, such as automotive applications where the panel and fastener assembly is coated or where the fastener assembly is subjected to oil, dirt and road debris.

[0020] Figures 3 and 4 illustrate the installation of the fastener 20 in a first panel 58. In a typical application, the panel 58 is steel, such as low carbon, 1010 steel or high strength, low alloy steel (HSLA), and the fastener 20 is formed of a harder steel, such that the barrel portion 22 will pierce the steel panel 58. A suitable material for the fastener is a 35 carbon steel with boron, such as a 10 B35 or 35B2 wherein the nut may be heat treated to Class 10. The fastener 20 may be installed in a die press and the panel 58 may be preloaded by a conventional stripper plate (not shown). In the installation shown in Figures 3 and 4, the fastener 20 is received in a fastener installation head in the upper die shoe of a die press (not shown), which includes a reciprocating plunger 60 which bears against the driven surface 56 of the flange portion 24. A female die member or die button 62 is located in the lower die shoe assembly (not shown) and the free end 28 of the barrel portion 22 is driven against the first panel 58 by the plunger 60, as shown by arrows 64. The die button 62 includes a bore 66 which receives the panel slug and an annular spanking lip 68 which deforms the panel into the groove 40 as described below in regard to Figure 4. The die button 62 further includes a relatively sharp piercing edge 70 adjacent the bore 66 which cooperates with the piercing edge 30 of the barrel portion 22 to pierce a slug from the panel, as now described.

[0021] In the method of this invention, the fastener 20 is first located by the installation head with the free end 28 of the barrel portion 22 located opposite the panel 58 coaxially aligned with the bore 66 of the die button 62 as shown in Figure 3. The plunger 60 is then actuated to drive the free end 28 of the barrel portion 22 against the panel and the relatively sharp cutting or piercing edge 30 of the barrel portion 22 cooperates with the relatively sharp cutting or piercing edge 70 of the die button to pierce a slug 72 from the panel, as shown in Figure 4. The V-shaped spanking lip 68 then deforms the panel portion 74 into the V-shaped groove 40 in the flange portion 24 and the outer annular bearing surface 38 is driven against the first panel 58 as shown in Figure 4. In the most preferred embodiment of the method of this invention, the cutting edge 70 of the die button simultaneously deforms an annular rib 76 radially outwardly from the radial shoulder 36 of the barrel portion shown in Figures 1 to 3. The annular radial rib 76 is driven against the deformed portion 74 of the first panel, entrapping the panel in the groove 40 and forming a mechanical interlock between the first panel 58 and the fastener 20. The spanking lip 68 of the die button 62 further deforms a shallow V-shaped annular recess 78 in the first panel which receives the second panel, as described below. Further, the enlarged diameter portion 34 of the barrel portion is driven through the pierced panel opening, providing an interference fit, further improving the pull-out strength of the fastener from the first panel assembly.

[0022] As described above, it is preferable particularly in mass production applications, to securely retain the fastener to the first panel, prior to receipt of the second panel, as described below. In a typical mass production application, the fastener 20 may be attached to the first panel 58 at one station and the second panel may be attached to the assembly at a later station. The first panel and fastener assembly may be loaded in bins, for example, subjecting the assembly to pull-out and vibrational forces. Further, as described above, the fastener and panel assembly of this invention preferably provides

an intimate mating contact between the panels and the fastener may be subject to substantial torque during attachment of a further element to the panel assembly, as described below. Thus, the fastener and first panel assembly is preferably mechanically interlocked to provide a secure installation prior to receipt of the second panel. In a typical application, the push-out strength of the fastener 20 in the first panel formed by the method of this invention is 8 kN or greater. Further, the radial ribs 42 are driven into the panel portion 74 as the enlarged diameter portion 34 of the barrel portion is driven into the panel opening, providing excellent torque resistance for the panel assembly. The first panel 58 and fastener assembly is now ready for receipt of the second panel, as described below.

[0023] The second panel 80 is prepierced for receipt of the barrel portion 22 and is preferably deformed adjacent the opening to form a conical lip surrounding the opening, which may be formed by the apparatus shown in Figures 5 and 6. The upper die platen 82 is attached to the upper die shoe 84 of the die press by conventional means. The lower die platen 86 includes a die member or die button 88 and a plunger 90 is attached to the upper die shoe by plate or bracket 91. The upper die platen includes a bore 92 which receives the plunger and an annular resilient bumper or bushing 94 is retained in a counter-bore in the bore 92. The die button 88 includes a central bore 96 which receives the plunger 90 and a die cavity 98 which forms the panel, as described below. The upper die shoe is spring biased by coil springs 100, normally separating the upper die platen 82 from the die shoe 84. When the upper die shoe 84 is lowered by the die press, the plunger 90 pierces a slug 102 from the panel, as shown in Figure 6. Continued downward movement of the upper die shoe 84 compresses spring 100, which drives the resilient plastic bushing 94 against the surface of the panel surrounding the pierced opening, deforming the panel into a generally conical lip 104, as best shown in Figures 6 and 7. The conical lip 104 extends from the plane of the panel 80 and includes an annular lip 106 spaced from the plane of the panel 80. The resilient bumper 94 forms the panel into the desired shape in the die cavity 98, as best shown in Figure 6. Further, details of this operation are disclosed in the US Patent 5,335,411. The second panel 80 is now ready for installation on the first panel and fastener assembly formed by the method disclosed in Figures 3 and 4, as described below in regard to Figures 8 and 9.

[0024] The installation apparatus includes an annular plunger 110 which is driven against the driven surface 56 of the flange portion 24 in an installation head (not shown). As described above in regard to the installation apparatus for installing the fastener in the first panel 58, the installation apparatus may be located in a conventional die press, such that the second panel 80 is attached to the fastener, with each stroke of the press. A die button 112 is located in the lower die platen which includes a central die post 114 configured to be received in the opening 110 formed in the second panel 80 as described above. Figure 8 is an exploded view of the assembly for illustrational purposes. In a normal application, the panel 80 will be located on the upper surface 120 of the die button and retained by the stripper plate of the die press. The die post 114 includes a concave arcuate surface 116 which blends into the axially upper surface 118 of the die post.

[0025] As shown in Figure 8, the second panel 80 is located in the die press with the annular edge 106 of the conical portion 104 of the second panel 80 facing the first panel 58. The opening 110 is configured to receive the barrel portion 22. When the plunger 110 is driven downwardly in Figure 8, as shown by arrows 122, the internal surface 46 of the barrel portion is received against the concave surface 116 of the die post, deforming the free end 28 of the barrel portion radially outwardly over the edge 104 of the second panel 80. The panel is simultaneously flattened between the upper surface 120 of the die member and the first panel 58, which deforms the conical lip 104 radially inwardly against the outer surface of the barrel portion and into the V-shaped recess in the first panel. The second panel 80 is thus deformed against the first panel 58, forming an intimate, mating, face-to-face contact between the panels and the free end of the barrel portion is deformed radially outwardly into an arcuate hook-shape over the edge of the second panel surrounding the second panel opening in intimate matting contact, forming a secure mechanical interlock between the barrel portion 22 and the second panel 80. The resultant fastener and panel assembly has excellent push-through, pull-out and torque resistance. The push-out strength of the panel assembly is about 15 kN or greater than about 3,000 lbs. The torque resistance in a typical application is about 120 newton meters.

[0026] Figures 10 and 11 illustrate a typical application of the fastener and panel assembly of this invention. Two fasteners 20 are installed in a bracket assembly 124 which comprises panels 58 and 80 by the method and apparatus described above. Both fasteners may be installed in the panels 58 and 80 simultaneously in a die press, as described. The disclosed bracket assembly 124 may be attached to a vehicle frame (not shown), for example, and a structural element 128, such as an axle assembly, is then attached to the bracket assembly by bolts 130. As shown in Figure 11, the threaded portion 132 of the bolt is received in the threaded bore 44 of the fastener 20 and the head 134 is driven against the structural element 128, securely retaining the structural element 128 to the bracket assembly 124. In a typical application, the bolt is driven into the nut fastener 20 by a torque wrench, subjecting the nut to substantial torque, particularly if the bolt is cross-threaded. Thus, substantial torque resistance of the fastener is required in many applications. In the most preferred embodiment, the free end 28 of the barrel portion is substantially flush with the second panel 80. Further tightening of the bolt 130, thus,

actually requalifies the fastener and panel assembly by further deforming the free end of the barrel portion against the panel assembly. Further, as described above, the panels are in intimate face-to-face contact, preventing any debris from entering between the panels. Finally, the fastener and panel assembly has excellent torque resistance, push-through and pull-out resistance, providing a very secure assembly, particularly for applications subject to vibrational and other forces.

[0027] Figures 12 and 13 illustrate a method of simultaneously piercing and deforming a plurality of panels 150 and 152 in nested relation. The panels 150 and 152 are supported on an annular surface 156 of a die member 154 having an annular die cavity 158 and a central bore 160 which receives the pierced panel slugs 162 and 164, respectively. The male die member 166 includes an arcuate conical lip 168 which deforms the panel portions 170 and 172 into the annular die cavity 158 as the punch 174 is driven against the panels, piercing the panel slugs 162 and 164 and forming an arcuate panel opening 178, as shown in Figure 13. The panel portion 150 is deformed into an arcuate generally frusto-conical lip 170 which blends into the conical lip 172 of panel 152. As described above, the panels 150 and 152 may be retained in face-to-face relation prior to piercing and forming, such as by spot welding, not shown. Further, the panels may first be pierced in a flat die, then deformed into the preferred nested frusto-conical shape as shown in Figure 13 in two steps. Finally, as described above in regard to Figure 10, a plurality of formed openings in the panels 150 and 152 may be formed for receipt of a plurality of fasteners 20. The nested panels 150 and 152 are now ready for attachment to the first panel and fastener assembly as shown in Figure 14.

[0028] As described above in regard to Figures 8 and 9, the first panel 58 may first be attached to the fastener 20 as described above in regard to Figures 3 and 4. The panels 150 and 152 are then reversed from the position shown in Figure 13, such that the frusto-conical portions 170 and 172 bear against the first panel 58, and the annular plunger 110 is then driven against the flange portion 24 in an installation head (not shown), which may be located in a die press. The die button 112 includes a central die post 114 which is configured to receive the free end 28 of the barrel portion, deforming the barrel portion 28 radially outwardly against the concave surface 116 of the die post. The frusto-conical lips 170 and 172 of the panels 150 and 152, respectively, are then flattened by driving the panels against the first panel 58, driving the lips radially inwardly against the outer surface of the barrel portion and the panel 152 deformed into the generally V-shaped recess 78 in the first panel, as described above. Thus, the method of this invention may be used to attach a plurality of panels to the fastener 20 as described herein.

[0029] As will be understood by those skilled in the art, various modifications may be made to the fastener and panel assembly and method of this invention within the purview of the appended claims. For example, as described above, the fastener may be a male fastener having a threaded or unthreaded shank extending from the flange portion 24 at 26. Further, the fastener may be a more conventional nut fastener, rather than the enclosed nut fastener disclosed, by removing the tubular portion 48. The installation apparatuses disclosed herein are for illustrational purposes only and other apparatus may be utilized to install the fastener and form the fastener and panel assembly by the method of this invention. Further, although the fastener is preferably installed in a die press, the fastener may be installed upwardly, wherein the die buttons are located in the upper die shoe or die platen. Finally, as described above, the fastener and panel assembly may include three or more panels which may require extending the barrel portion 22 of the fastener. Where the "second" panel comprises two or more panels, the panels are preferably formed with an upstanding generally conical lip 104, as described above in regard to Figures 12 and 13. The panels may then be nested and installed simultaneously or sequentially.

[0030] Turning now to Figure 15 there can be seen a nut element 20similar to that of Figure 2 but having a knurled region in the form of axial splines 42A at the level of the axial portion of the ribs 42 in Figure 2. Although the right-hand half of Figure 15 shows the axial portion of the ribs 42 of the Figure 2 embodiment it will be understood that this is solely for the purpose of illustration and that the knurled region 42A in fact extends around the full circumference of the nut. In fact the knurled region will typically end in the axial direction just short of a radial plane defining the lower side 38 of the flange of the nut element to facilitate the manufacturing of the knurled region. Actually the knurled region in the form of axial splines need not be formed by a knurling operation it could also be formed by cold heading or upsetting.

[0031] The installation of the nut 20 of Figur 15 takes place in just the same way as the installation of the nut of Figure 2 and the knurled splines 42A serve in the same way as the axial portions of the ribs 42 to provide security against rotation. In this embodiment there are no radial ribs in the annular groove 40 beneath the flange, however such radial ribs could be provided if desired and would enhance the anti-rotation properties of the fastener.

[0032] Although the nut element described so far is sealed at the top by a disc 50, this disc 50 could also be omitted if desired.

Claims

1. A method of riveting a plurality of plastically deformable panels (58, 80; 58, 152, 150) together in face-to-face relation and attaching a fastener (20) to said panels for attachment of a further element (128) to

said panels (58, 80; 58, 152, 150), said fastener (20) including a tubular barrel portion (22), a flange portion (24) extending radially from adjacent said barrel portion and a fastener portion (26) generally opposite said barrel portion (22), said method comprising the following steps:

a) locating said fastener (20) opposite a first panel (58) with the free end (28) of said barrel portion (22) facing said first panel;
b) driving said fastener barrel portion free end (28) through an opening formed in said first panel (58);
c) receiving said flange portion (24) against said panel (58) and securing said fastener (20) to said panel (58) by deforming an outer surface of said barrel portion (22) spaced from said free end (28) radially outwardly and against said first panel (58) to form a mechanical interlock between said barrel portion (22) and said first panel (58);
d) forming an opening in a second panel (80; 152, 150) configured to receive said fastener barrel portion (22);
e) locating said second panel (80; 150, 152) on said first panel (58) in face-to-face relation, with said fastener barrel portion (22) extending substantially through said second panel opening; and
f) deforming said fastener barrel portion (22) radially outwardly to securely rivet said second panel (80; 150, 152) to said first panel (58) and mechanically affix said fastener (20) to said panels (58, 80; 58, 152, 150), with said fastener portion (26) extending from said first panel (58) for attachment of said further element (126) to said panels (58, 80; 58, 152, 150).

2. A method in accordance with claim 1, wherein said step of driving said barrel portion free end through an opening formed in said panel comprises the step of driving said barrel portion free end (28) against said first panel (58) to pierce said opening in said first panel (58).

3. A method in accordance with claim 1, wherein said step of driving said barrel portion free end (28) through an opening formed in said first panel (58) comprises the step of forming said opening and then driving said barrel portion (22) towards said first panel opening and receiving said flange portion (24) against said first panel (58).

4. A method in accordance with any one of the preceding claims, wherein said flange portion includes an annular groove (40) generally surrounding said barrel portion adjacent said barrel portion, the method comprising the step of deforming said first panel (58) adjacent said opening into said flange portion annular groove (40).

5. A method in accordance with any one of the preceding claims and comprising the further steps of deforming said second panel (80; 152, 150) adjacent said opening to form a generally conical lip (104; 172) surrounding said second panel opening, locating said second panel (80; 152, 150) on said first panel (58) in face-to-face relation with said fastener barrel portion (22) extending substantially through said second panel opening and said generally conical lip (104; 172) engaging said first panel (58); and deforming said fastener barrel portion (22) radially outwardly and substantially simultaneously deforming said conical lip (104) of said second panel (80; 152, 150) radially inwardly against said first panel (58) to securely rivet said second panel to said first panel and mechanically lock said fastener (20) to said panels (58, 80; 58, 152, 150) with said fastener portion (26) extending from said first panel (58) for attachment of said further element (128) to said panels (58, 80; 58, 152, 150).

6. A method in accordance with any one of the preceding claims, wherein said fastener tubular barrel portion (22) has a first outside diameter (32) adjacent said free end (28) which is less than a second outside diameter (34) adjacent said flange portion (24) defining a generally radial shoulder (36) on said barrel portion (22), wherein said step of deforming an outer surface of said barrel portion comprises the step of deforming said radial shoulder (36) toward said flange portion (24) and radially outwardly to form said mechanical interlock.

7. A method in accordance with claim 4, wherein said annular groove (40) includes a plurality of radial ribs (42) bridging said groove (40), the method including the step of deforming said first panel into said annular groove (40) around said ribs (42), thus preventing rotation of said fastener (20) in said first panel (58).

8. A method in accordance with claim 7, wherein said method includes deforming said first panel (58) in said flange portion annular groove (40) forming an annular recess (78) in said first panel (58), then locating said second panel (80; 152, 150) on said first panel with a free edge (106) of said conical lip (104; 172) located in said first panel annular recess (78).

9. A method in accordance with claim 8, wherein the step of deforming said conical lip (104; 172) of said second panel (80; 152, 150) against said first panel comprises the step of deforming said second panel (80; 152, 150) substantially flat against said first panel (58), thereby deforming said conical lip (104;

172) radially inwardly against said fastener barrel portion (22) as said barrel portion free end (28) is deformed radially outwardly against said second panel (80; 152, 150), forming a secure mechanical interlock between said barrel portion free end (28) and said second panel (80; 152, 150).

10. A method in accordance with any one of the preceding claims, wherein said barrel portion free end (28) has an outer piercing edge (30) and said method including driving said barrel portion free end (28) against said first panel (58) to pierce a slug (72) from said panel (58) to form said first panel opening with an inside diameter generally equal to that of said barrel portion free end (28).

11. A method in accordance with claim 10, wherein said barrel portion free end (28) has a first diameter (32) adjacent to said barrel portion free end (28) smaller than a second diameter (34) adjacent said flange portion (24), the method comprising the step of driving said barrel portion (22) through said first panel opening to receive said larger second diameter (34) in said first panel opening, retaining said fastener (20) in said first panel opening.

12. A method in accordance with any one of the preceding claims, in which the fastener is provided with axial splines (42A) on the barrel portion (22) adjacent the flange portion (24) in the area of the connection of the fastener (20) to the first said panel (58) and said end of said barrel portion (22) remote from said flange optionally having a chamfer (31), the method comprising the step of deforming said first panel (58) into engagement with said axial splines (42A).

13. A method in accordance with any one of the preceding claims comprising the steps of

a) locating a plurality of second panels (152, 150) in face-to-face relationship;
b) piercing an opening (178) in said second panels (152, 150) and deforming said panels adjacent said opening to form nested upstanding generally frusto-conical lips (170, 172) in said panels having an inside diameter generally equal to an outside surface of said barrel portion;
c) placing said second panels (152, 150) so that said frusto-conical lips (170, 172) bear against the first panel (58), and
d) flattening the frusto-conical lips by driving the second panels (152, 150) against the first panel (58), thus driving the conical lips (170, 172) radially inwardly against the outer surface of the barrel portion (22).

14. A fastener and panel assembly, including a plurality of plastically deformable panels (58, 80; 58, 152, 150) permanently retained in face-to-face relation, comprising: a fastener (20) including a barrel portion (22), a flange portion (24) extending radially from adjacent said barrel portion (22) generally perpendicular to said barrel portion and a fastener portion (26) generally opposite said barrel portion (22), said flange portion (24) having an annular groove (40) adjacent said barrel portion generally surrounding said barrel portion, a first panel (58) having an opening receiving said fastener barrel portion (22) therethrough bearing against said flange portion (24) and deformed in said flange portion groove (40) and retained to said fastener by a mechanical interlock, a second panel (80; 152, 150) overlying said first panel (58) having an opening receiving said barrel portion (22) therethrough, and said barrel portion having a free end (28) deformed radially outwardly over said second panel (80; 152, 150) permanently attaching said panels (58, 80; 58, 152, 150) in face-to-face relation and said fastener portion (26) extending from said first panel (58) for the attachment of another element (128) to said panels.

15. A fastener and panel assembly in accordance with claim 14, wherein said first panel (58) includes an annular panel groove (78) surrounding and spaced from said barrel portion (22) and said second panel (80; 152, 150) is deformed in said first panel groove (78).

16. The fastener and panel assembly in accordance with claim 15, wherein said groove (40) in said flange portion (24) is generally V-shaped extending radially inwardly toward said barrel portion (22), and said first panel is deformed into said V-shaped groove (40) to substantially fill said flange portion groove (40).

17. A fastener and panel assembly in accordance with claim 16, wherein said first panel (58) is deformed into said V-shaped groove (40) in said flange portion (24) forming a generally V-shaped annular recess (78) in said first panel (58) opposite said flange portion (24) surrounding said barrel portion (22), with said second panel (80; 152, 150) being deformed in said annular recess (78) in said first panel (58) and radially inwardly against said barrel portion (22) forming close face-to-face mating contact between said panels (58, 80; 58, 152, 150).

18. A fastener and panel assembly in accordance with any one of the preceding claims 14 to 17, wherein said flange portion annular groove (40) includes a plurality of radial ribs (42) and said first panel (58) is deformed in said V-shaped groove of said flange portion (24) around said radial ribs (42) preventing

rotation of said fastener relative to said panels (58, 80; 58, 152, 150).

19. The fastener and panel assembly defined in any one of the claims 14 to 18, characterized in that an outer surface of said barrel portion (22) is deformed radially outwardly spaced from said free end to form a radial annular rib (76) bearing against said first panel (58), entrapping said first panel (58) in said flange groove (40).

20. The fastener and panel assembly defined in any one of the claims 14 to 19, characterized in that said barrel portion (22) includes a first portion adjacent said flange portion having an outside diameter (34) greater than a second barrel portion adjacent said free end (28).

21. The fastener and panel assembly defined in any one of the claims 14 to 20, characterized in that said barrel portion free end (28) is deformed radially outwardly in an arcuate hook-shape over an edge of said second panel (80; 152, 150) surrounding said second panel opening and said second panel is deformed radially inwardly against said barrel portion (22) forming an intimate mating contact between said second panel (80; 152, 150) and said barrel portion (22).

Patentansprüche

1. Verfahren, um eine Vielzahl von plastisch verformbaren Tafeln (58, 80; 58, 152, 150) in gegenüberliegender Beziehung aneinander zu nieten und ein Befestigungselement (20) an den Tafeln für eine Befestigung eines weiteren Elementes (128) an den Tafeln (58, 80; 58, 152, 150) zu befestigen, wobei das Befestigungselement (20) einen rohrförmigen Zylinderabschnitt (22), einen Flanschabschnitt (24), der sich radial von benachbart des Zylinderabschnittes erstreckt, und einen Befestigungsabschnitt (26) aufweist, der dem Zylinderabschnitt (22) im allgemeinen gegenüberliegt, wobei das Verfahren die folgenden Schritte umfaßt, daß:

   a) das Befestigungselement (20) gegenüberliegend einer ersten Tafel (58) angeordnet wird, wobei das freie Ende (28) des Zylinderabschnittes (22) zu der ersten Tafel weist;
   b) das freie Ende (28) des Zylinderabschnittes des Befestigungselementes durch eine in der ersten Tafel (58) geformte Öffnung getrieben wird;
   c) der Flanschabschnitt (24) an der Tafel (58) aufgenommen wird und das Befestigungselement (20) an der Tafel (58) dadurch gesichert wird, daß eine Außenfläche des Zylinderabschnittes (22), die von dem freien Ende (28) beabstandet ist, radial nach außen und an die erste Tafel (58) verformt wird, um eine mechanische Verriegelung zwischen dem Zylinderabschnitt (22) und der ersten Tafel (58) zu bilden;
   d) eine Öffnung in einer zweiten Tafel (80; 152, 150) gebildet wird, die so ausgestaltet ist, daß sie den Zylinderabschnitt (22) des Befestigungselementes aufnehmen kann;
   e) die zweite Tafel (80; 150, 152) an der ersten Tafel (58) in gegenüberliegender Beziehung angeordnet wird, wobei sich der Zylinderabschnitt (22) des Befestigungselementes im wesentlichen durch die Öffnung der zweiten Tafel erstreckt; und
   f) der Zylinderabschnitt (22) des Befestigungselementes radial nach außen verformt wird, um die zweite Tafel (80; 150, 152) sicher an die erste Tafel (58) zu nieten und das Befestigungselement (20) mechanisch an die Tafeln (58, 80; 58, 152, 150) zu befestigen, wobei sich der Befestigungsabschnitt (26) von der ersten Tafel (58) für eine Befestigung des weiteren Elementes (126) an den Tafeln (58, 80; 58, 152, 150) erstreckt.

2. Verfahren nach Anspruch 1, wobei der Schritt, bei dem das freie Ende des Zylinderabschnittes durch eine in der Tafel gebildete Öffnung getrieben wird, den Schritt umfaßt, daß das freie Ende (28) des Zylinderabschnittes an die erste Tafel (58) getrieben wird, um die Öffnung in der ersten Tafel (58) zu stechen.

3. Verfahren nach Anspruch 1, wobei der Schritt, bei dem das freie Ende (28) des Zylinderabschnittes durch eine in der ersten Tafel (58) geformte Öffnung getrieben wird, den Schritt umfaßt, daß die Öffnung gebildet und dann der Zylinderabschnitt (22) an die Öffnung der ersten Tafel getrieben und der Flanschabschnitt (24) an der ersten Tafel (58) aufgenommen wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei der Flanschabschnitt eine ringförmige Nut (40), die den Zylinderabschnitt im allgemeinen umgibt, benachbart des Zylinderabschnittes umfaßt, wobei das Verfahren den Schritt umfaßt, daß die erste Tafel (58) benachbart der Öffnung in die ringförmige Nut (40) des Flanschabschnittes verformt wird.

5. Verfahren nach einem der vorhergehenden Ansprüche mit den weiteren Schritten, daß die zweite Tafel (80; 152, 150) benachbart der Öffnung verformt wird, um eine im allgemeinen konische Lippe (104; 172) zu bilden, welche die Öffnung der zweiten Tafel umgibt, die zweite Tafel (80; 152, 150) an der ersten

Tafel (58) in gegenüberliegender Beziehung angeordnet wird, wobei sich der Zylinderabschnitt (22) des Befestigungselementes im wesentlichen durch die Öffnung der zweiten Tafel erstreckt und die im allgemeinen konische Lippe (104; 172) mit der ersten Tafel (58) in Eingriff tritt; und der Zylinderabschnitt (22) des Befestigungselementes radial nach außen verformt wird und im wesentlichen gleichzeitig die konische Lippe (104) der zweiten Tafel (80; 152, 150) radial nach innen an die erste Tafel (58) verformt wird, um die zweite Tafel sicher an die erste Tafel zu nieten und das Befestigungselement (20) mechanisch an den Tafeln (58, 80; 58, 152, 150) zu verriegeln, wobei sich der Befestigungsabschnitt (26) von der ersten Tafel (58) zur Befestigung des weiteren Elementes (128) an den Tafeln (58, 80; 58, 152, 150) erstreckt.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei der rohrförmige Zylinderabschnitt (22) des Befestigungselementes einen ersten Außendurchmesser (32) benachbart des freien Endes (28) aufweist, der kleiner als ein zweiter Außendurchmesser (34) benachbart des Flanschabschnittes (24) ist, wobei eine im allgemeinen radiale Schulter (36) an dem Zylinderabschnitt (22) definiert wird, wobei der Schritt, bei dem eine Außenfläche des Zylinderabschnittes verformt wird, den Schritt umfaßt, daß die radiale Schulter (36) an den Flanschabschnitt (24) und radial nach außen verformt wird, um die mechanische Verriegelung zu bilden.

7. Verfahren nach Anspruch 4, wobei die ringförmige Nut (40) eine Vielzahl von radialen Rippen (42) umfaßt, welche die Nut (40) überbrükken, wobei das Verfahren den Schritt umfaßt, daß die erste Tafel in die ringförmige Nut (40) um die Rippen (42) herum verformt wird, wodurch eine Drehung des Befestigungselementes (20) in der ersten Tafel (58) verhindert wird.

8. Verfahren nach Anspruch 7, wobei das Verfahren umfaßt, daß die erste Tafel (58) in die ringförmige Nut (40) des Flanschabschnittes verformt wird, wobei eine ringförmige Vertiefung (78) in der ersten Tafel (58) gebildet wird, die zweite Tafel (80; 152, 150) dann an der ersten Tafel angeordnet wird, wobei ein freier Rand (106) der konischen Lippe (104; 172) in der ringförmigen Vertiefung (78) der ersten Tafel angeordnet wird.

9. Verfahren nach Anspruch 8, wobei der Schritt, bei dem die konische Lippe (104; 172) der zweiten Tafel (80; 152, 150) an die erste Tafel verformt wird, den Schritt umfaßt, daß die zweite Tafel (80; 152, 150) im wesentlichen flach an die erste Tafel (58) verformt wird, wodurch die konische Lippe (104; 172) radial nach innen an den Zylinderabschnitt (22) des Befestigungselementes verformt wird, wenn das freie Ende (28) des Zylinderabschnittes radial nach außen an die zweite Tafel (80; 152, 150) verformt wird, wobei eine sichere mechanische Verriegelung zwischen dem freien Ende (28) des Zylinderabschnittes und der zweiten Tafel (80; 152, 150) gebildet wird.

10. Verfahren nach einem der vorhergehenden Ansprüche, wobei das freie Ende (28) des Zylinderabschnittes einen äußeren Durchstechrand (30) aufweist und wobei das Verfahren umfaßt, daß das freie Ende (28) des Zylinderabschnittes an die erste Tafel (58) getrieben wird, um einen Butzen (72) aus der Tafel (58) zu stechen und damit die Öffnung der ersten Tafel zu bilden, die einen Innendurchmesser aufweist, der im allgemeinen gleich dem des freien Endes (28) des Zylinderabschnittes ist.

11. Verfahren nach Anspruch 10, wobei das freie Ende (28) des Zylinderabschnittes einen ersten Durchmesser (32) benachbart des freien Endes (28) des Zylinderabschnittes aufweist, der kleiner als ein zweiter Durchmesser (34) benachbart des Flanschabschnittes (24) ist, wobei das Verfahren den Schritt umfaßt, daß der Zylinderabschnitt (22) durch die Öffnung der ersten Tafel getrieben wird, um den größeren zweiten Durchmesser (34) in der Öffnung der ersten Tafel aufnehmen zu können, wobei das Befestigungselement (20) in der Öffnung der ersten Tafel gehalten wird.

12. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Befestigungselement mit axialen Keilen (42A) an dem Zylinderabschnitt (22) benachbart des Flanschabschnittes (24) in dem Bereich der Verbindung des Befestigungselementes (20) mit der ersten Tafel (58) versehen ist, und wobei das Ende des Zylinderabschnittes (22), das von dem Flansch entfernt ist, wahlweise eine Abschrägung (31) aufweist, wobei das Verfahren den Schritt umfaßt, daß die erste Tafel (58) in Eingriff mit den axialen Keilen (42A) verformt wird.

13. Verfahren nach einem der vorhergehenden Ansprüche mit den Schritten, daß

a) eine Vielzahl von zweiten Tafeln (152, 150) in gegenüberliegender Beziehung angeordnet wird;
b) eine Öffnung (178) in den zweiten Tafeln (152, 150) gestochen wird und die Tafeln benachbart der Öffnung verformt werden, um ineinander angeordnete, stehende, im allgemeinen kegelstumpfförmige Lippen (170, 172) in den Tafeln zu bilden, die einen Innendurchmesser aufweisen, der im allgemeinen gleich einer Außenfläche des Zylinderabschnittes ist;

c) die zweiten Tafeln (152, 150) so angeordnet werden, daß die kegelstumpfförmigen Lippen (170, 172) an der ersten Tafel (58) anliegen, und

d) die kegelstumpfförmigen Lippen dadurch abgeflacht werden, daß die zweiten Tafeln (152, 150) an die erste Tafel (58) getrieben werden, wodurch die konischen Lippen (170, 172) radial nach innen an die Außenfläche des Zylinderabschnittes (22) getrieben werden.

14. Befestigungselement- und Tafelaufbau mit einer Vielzahl von plastisch verformbaren Tafeln (58, 80; 58, 152, 150), die dauerhaft in gegenüberliegender Beziehung gehalten werden, mit: einem Befestigungselement (20), das einen Zylinderabschnitt (22), einen Flanschabschnitt (24), der sich radial von benachbart des Zylinderabschnittes (22) im allgemeinen rechtwinklig zu dem Zylinderabschnitt erstreckt, und einen Befestigungsabschnitt (26) umfaßt, der dem Zylinderabschnitt (22) im allgemeinen gegenüberliegt, wobei der Flanschabschnitt (24) eine ringförmige Nut (40) benachbart dem Zylinderabschnitt aufweist, die den Zylinderabschnitt im allgemeinen umgibt, einer ersten Tafel (58), die eine Öffnung aufweist, welche den Zylinderabschnitt (22) des Befestigungselementes hindurch aufnimmt, und an dem Flanschabschnitt (24) anliegt und in die Nut (40) des Flanschabschnittes verformt wird und an dem Befestigungselement durch eine mechanische Verriegelung gehalten wird, einer zweiten Tafel (80; 152, 150), die über der ersten Tafel (58) liegt und eine Öffnung aufweist, welche den Zylinderabschnitt (22) hindurch aufnimmt, und wobei der Zylinderabschnitt ein freies Ende (28) aufweist, das über die zweite Tafel (80; 152, 150) radial nach außen verformt wird, wobei die Tafeln (58, 80; 58, 152, 150) in gegenüberliegender Beziehung dauerhaft befestigt werden und sich der Befestigungsabschnitt (26) von der ersten Tafel (58) für die Befestigung eines anderen Elementes (128) an den Tafeln erstreckt.

15. Befestigungselement- und Tafelaufbau nach Anspruch 14, wobei die erste Tafel (58) eine ringförmige Tafelnut (78) aufweist, welche den Zylinderabschnitt (22) umgibt und von diesem beabstandet ist, und die zweite Tafel (80; 152, 150) in die Nut (78) der ersten Tafel verformt wird.

16. Befestigungselement- und Tafelaufbau nach Anspruch 15, wobei die Nut (40) in dem Flanschabschnitt (24) im allgemeinen V-förmig ist, wobei sie sich radial einwärts in Richtung des Zylinderabschnittes (22) erstreckt, und die erste Tafel in die V-förmige Nut (40) verformt wird, um die Nut (40) des Flanschabschnittes im wesentlichen zu füllen.

17. Befestigungselement- und Tafelaufbau nach Anspruch 16, wobei die erste Tafel (58) in die V-förmige Nut (40) in dem Flanschabschnitt (24) verformt ist, wobei eine im allgemeinen V-förmige ringförmige Vertiefung (78) in der ersten Tafel (58) gegenüberliegend dem Flanschabschnitt (24) gebildet wird, der den Zylinderabschnitt (22) umgibt, wobei die zweite Tafel (80; 152, 150) in die ringförmige Vertiefung (78) in der ersten Tafel (58) und radial einwärts an den Zylinderabschnitt (22) verformt wird, wobei ein enger gegenüberliegender zusammenpassender Kontakt zwischen den Tafeln (58, 80; 58, 152, 150) gebildet wird.

18. Befestigungselement- und Tafelaufbau nach einem der vorhergehenden Ansprüche 14 bis 17, wobei die ringförmige Nut (40) des Flanschabschnittes eine Vielzahl von radialen Rippen (42) aufweist und die erste Tafel (58) in die V-förmige Nut des Flanschabschnittes (24) um die radialen Rippen (42) verformt wird, wobei eine Drehung des Befestigungselementes relativ zu den Tafeln (58, 80; 58, 152, 150) verhindert wird.

19. Befestigungselement- und Tafelaufbau nach einem der Ansprüche 14 bis 18, dadurch gekennzeichnet, daß eine Außenfläche des Zylinderabschnittes (22) radial nach außen beabstandet von dem freien Ende verformt wird, um eine radiale ringförmige Rippe (76) zu bilden, die an die erste Tafel (58) anliegt, wobei die erste Tafel (58) in die Flanschnut (40) eingeschlossen wird.

20. Befestigungselement- und Tafelaufbau nach einem der Ansprüche 14 bis 19, dadurch gekennzeichnet, daß der Zylinderabschnitt (22) einen ersten Abschnitt benachbart dem Flanschabschnitt aufweist, der einen Außendurchmesser (34) aufweist, der größer als ein zweiter Zylinderabschnitt benachbart dem freien Ende (28) ist.

21. Befestigungselement- und Tafelaufbau nach einem der Ansprüche 14 bis 20, dadurch gekennzeichnet, daß das freie Ende (28) des Zylinderabschnittes radial nach außen in einer bogenförmigen Hakenform über einen Rand der zweiten Tafel (80; 152, 150) verformt wird, der die Öffnung der zweiten Tafel umgibt, und die zweite Tafel radial einwärts an den Zylinderabschnitt (22) verformt wird, wobei ein enger zusammenpassender Kontakt zwischen der zweiten Tafel (80; 152, 150) und dem Zylinderabschnitt (22) gebildet wird.

Revendications

1. Procédé pour assembler par rivetage une pluralité de panneaux déformables plastiquement (58, 80 ;

58, 152, 150) en une relation de face à face et fixer une attache (20) auxdits panneaux pour fixation d'un élément supplémentaire (128) auxdits panneaux (58, 80 ; 58, 152, 150), ladite attache (20) comprenant une partie de cylindre tubulaire (22), une partie de rebord (24) s'étendant radialement depuis ladite partie de cylindre adjacente et une partie d'attache (26) généralement à l'opposé de ladite partie de cylindre (22), ledit procédé comprenant les phases suivantes consistant à :

a) positionner ladite attache (20) en face d'un premier panneau (58) avec l'extrémité libre (28) de ladite partie de cylindre (22) donnant sur ledit premier panneau ;
b) entraîner ladite extrémité libre de partie de cylindre d'attache (28) dans une ouverture formée dans ledit premier panneau (58) ;
c) recevoir ladite partie de rebord (24) contre ledit panneau (58) et fixer ladite attache (20) audit panneau (58) en déformant une surface externe de ladite partie de cylindre (22) espacée de ladite extrémité libre (28) radialement vers l'extérieur et contre ledit premier panneau (58) afin de former un verrouillage mécanique réciproque entre ladite partie de cylindre (22) et ledit premier panneau (58) ;
d) former une ouverture dans un deuxième panneau (80 ; 152, 150), configurée pour recevoir ladite partie de cylindre d'attache (22) ;
e) positionner ledit deuxième panneau (80 ; 150, 152) sur ledit premier panneau (58) en une relation de face à face, avec ladite partie de cylindre d'attache (22) s'étendant sensiblement dans ladite ouverture de deuxième panneau ; et
f) déformer ladite partie de cylindre d'attache (22) radialement vers l'extérieur afin de riveter solidement ledit deuxième panneau (80 ; 150, 152) audit premier panneau (58) et fixer mécaniquement ladite attache (20) auxdits panneaux (58, 80 ; 58, 152, 150), avec ladite partie d'attache (26) s'étendant depuis ledit premier panneau (58) pour fixation dudit élément supplémentaire (128) auxdits panneaux (58, 80 ; 58, 152, 150).

2. Procédé selon la revendication 1, dans lequel ladite phase d'entraînement de ladite extrémité libre de partie de cylindre dans une ouverture formée dans ledit panneau comprend la phase consistant à entraîner ladite extrémité libre de partie de cylindre (28) contre ledit premier panneau (58) afin de percer ladite ouverture dans ledit premier panneau (58).

3. Procédé selon la revendication 1, dans lequel ladite phase d'entraînement de ladite extrémité libre de partie de cylindre (28) dans une ouverture formée dans ledit premier panneau (58) comprend la phase consistant à former ladite ouverture puis entraîner ladite partie de cylindre (22) vers ladite ouverture de premier panneau et recevoir ladite partie de rebord (24) contre ledit premier panneau (58).

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite partie de rebord comprend une rainure annulaire (40) entourant généralement ladite partie de cylindre, adjacente à ladite partie de cylindre, le procédé comprenant la phase consistant à déformer ledit premier panneau (58) près de ladite ouverture dans ladite rainure annulaire de partie de rebord (40).

5. Procédé selon l'une quelconque des revendications précédentes et comprenant les phases supplémentaires consistant à déformer ledit deuxième panneau (80 ; 152, 150) près de ladite ouverture afin de former un bec généralement conique (104 ; 172) entourant ladite ouverture de deuxième panneau, positionner ledit deuxième panneau (80 ; 152, 150) sur ledit premier panneau (58) en une relation de face à face avec ladite partie de cylindre d'attache (22) s'étendant sensiblement dans ladite ouverture de deuxième panneau et ledit bec généralement conique (104 ; 172) engageant ledit premier panneau (58) ; et déformer ladite partie de cylindre d'attache (22) radialement vers l'extérieur et déformer sensiblement simultanément ledit bec conique (104) dudit deuxième panneau (80 ; 152, 150) radialement vers l'intérieur contre ledit premier panneau (58) afin de riveter solidement ledit deuxième panneau audit premier panneau et verrouiller mécaniquement ladite attache (20) auxdits panneaux (58, 80; 58, 152, 150) avec ladite partie d'attache (26) s'étendant depuis ledit premier panneau (58) pour fixation dudit élément supplémentaire (128) auxdits panneaux (58, 80 ; 58, 152, 150).

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite partie de cylindre tubulaire d'attache (22) présente un premier diamètre extérieur (32) adjacent à ladite extrémité libre (28) qui est inférieur à un deuxième diamètre extérieur (34) adjacent à ladite partie de rebord (24) définissant un épaulement généralement radial (36) sur ladite partie de cylindre (22), dans lequel ladite phase de déformation d'une surface externe de ladite partie de cylindre comprend la phase consistant à déformer ledit épaulement radial (36) vers ladite partie de rebord (24) et radialement vers l'extérieur afin de former ledit verrouillage mécanique réciproque.

7. Procédé selon la revendication 4, dans lequel ladite rainure annulaire (40) comprend une pluralité de

nervures radiales (42) formant un pont sur ladite rainure (40), le procédé comprenant la phase consistant à déformer ledit premier panneau dans ladite rainure annulaire (40) autour desdites nervures (42), ce qui empêche une rotation de ladite attache (20) dans ledit premier panneau (58).

8. Procédé selon la revendication 7, dans lequel ledit procédé comprend une déformation dudit premier panneau (58) dans ladite rainure annulaire de partie de rebord (40) formant un évidement annulaire (78) dans ledit premier panneau (58), puis le positionnement dudit deuxième panneau (80 ; 152, 150) sur ledit premier panneau avec un bord libre (106) dudit bec conique (104 ; 172) positionné dans ledit évidement annulaire de premier panneau (78).

9. Procédé selon la revendication 8, dans lequel la phase de déformation dudit bec conique (104 ; 172) dudit deuxième panneau (80 ; 152, 150) contre ledit premier panneau comprend la phase consistant à déformer ledit deuxième panneau (80 ; 152, 150) sensiblement plat contre ledit premier panneau (58), ce qui déforme ledit bec conique (104 ; 172) radialement vers l'intérieur contre ladite partie de cylindre d'attache (22) tandis que ladite extrémité libre de partie de cylindre (28) est déformée radialement vers l'extérieur contre ledit deuxième panneau (80 ; 152, 150), ce qui forme un verrouillage mécanique réciproque sûr entre ladite extrémité libre de partie de cylindre (28) et ledit deuxième panneau (80 ; 152, 150).

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite extrémité libre de partie de cylindre (28) comporte un bord de perçage externe (30) et ledit procédé comprenant un entraînement de ladite extrémité libre de partie de cylindre (28) contre ledit premier panneau (58) pour percer un morceau (72) dudit panneau (58) afin de former ladite ouverture de premier panneau avec un diamètre intérieur généralement égal à celui de ladite extrémité libre de partie de cylindre (28).

11. Procédé selon la revendication 10, dans lequel ladite extrémité libre de partie de cylindre (28) présente un premier diamètre (32) adjacent à ladite extrémité libre de partie de cylindre (28) inférieur à un deuxième diamètre (34) adjacent à ladite partie de rebord (24), le procédé comprenant la phase consistant à entraîner ladite partie de cylindre (22) dans ladite ouverture de premier panneau pour recevoir ledit deuxième diamètre plus grand (34) dans ladite ouverture de premier panneau, ce qui retient ladite attache (20) dans ladite ouverture de premier panneau.

12. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'attache est dotée de cannelures axiales (42A) sur la partie de cylindre (22) adjacente à la partie de rebord (24) dans la zone de connexion de l'attache (20) audit premier panneau (58) et ladite extrémité de ladite partie de cylindre (22) éloignée dudit rebord comporte, éventuellement, un chanfrein (31), le procédé comprenant la phase consistant à déformer ledit premier panneau (58) en engagement avec lesdites cannelures axiales (42A).

13. Procédé selon l'une quelconque des revendications précédentes, comprenant les phases consistant à :

a) positionner une pluralité de deuxièmes panneaux (152, 150) en une relation de face à face ;
b) percer une ouverture (178) dans lesdits deuxièmes panneaux (152, 150) et déformer lesdits panneaux près de ladite ouverture pour former des becs généralement tronconiques dressés, encastrés (170, 172) dans lesdits panneaux présentant un diamètre intérieur généralement égal à une surface externe de ladite partie de cylindre ;
c) placer lesdits deuxièmes panneaux (152, 150) de manière que lesdits becs tronconiques (170, 172) portent contre le premier panneau (58), et
d) aplatir les becs tronconiques en entraînant les deuxièmes panneaux (152, 150) contre le premier panneau (58), ce qui entraîne les becs coniques (170, 172) radialement vers l'intérieur contre la surface externe de la partie de cylindre (22).

14. Ensemble d'attache et de panneaux, comprenant une pluralité de panneaux déformables plastiquement (58, 80 ; 58, 152, 150) retenus de manière permanente en une relation de face à face, comprenant : une attache (20) comprenant une partie de cylindre (22), une partie de rebord (24) s'étendant radialement depuis ladite partie de cylindre adjacente (22) généralement perpendiculairement à ladite partie de cylindre et une partie d'attache (26) généralement à l'opposé de ladite partie de cylindre (22), ladite partie de rebord (24) comportant une rainure annulaire (40) adjacente à ladite partie de cylindre, entourant généralement ladite partie de cylindre, un premier panneau (58) comportant une ouverture recevant ladite partie de cylindre d'attache (22) en son sein, portant contre ladite partie de rebord (24) et déformée dans ladite rainure de partie de rebord (40) et retenu à ladite attache par un verrouillage mécanique réciproque, un deuxième panneau (80; 152, 150) recouvrant ledit premier panneau (58) et comportant une ouverture recevant ladite partie de cylindre (22) en son sein, et ladite

partie de cylindre comportant une extrémité libre (28) déformée radialement vers l'extérieur sur ledit deuxième panneau (80 ; 152, 150), fixant de manière permanente lesdits panneaux (58, 80 ; 58, 152, 150) en une relation de face à face et ladite partie d'attache (26) s'étendant depuis ledit premier panneau (58) pour la fixation d'un autre élément (128) auxdits panneaux.

15. Ensemble d'attache et de panneaux selon la revendication 14, dans lequel ledit premier panneau (58) comprend une rainure de panneau annulaire (78) entourant ladite partie de cylindre (22) et espacée de celle-ci et ledit deuxième panneau (80 ; 152, 150) est déformé dans ladite rainure de premier panneau (78).

16. Ensemble d'attache et de panneaux selon la revendication 15, dans lequel ladite rainure (40) dans ladite partie de rebord (24) a généralement la forme d'un V s'étendant radialement vers l'intérieur vers ladite partie de cylindre (22), et ledit premier panneau est déformé dans ladite rainure en forme de V (40) pour remplir sensiblement ladite rainure de partie de rebord (40).

17. Ensemble d'attache et de panneaux selon la revendication 16, dans lequel ledit premier panneau (58) est déformé dans ladite rainure en forme de V (40) dans ladite partie de rebord (24), ce qui forme un évidement annulaire généralement en forme de V (78) dans ledit premier panneau (58) à l'opposé de ladite partie de rebord (24) entourant ladite partie de cylindre (22), avec ledit deuxième panneau (80 ; 152, 150) étant déformé dans ledit évidement annulaire (78) dans ledit premier panneau (58) et radialement vers l'intérieur contre ladite partie de cylindre (22), ce qui forme un contact d'accouplement étroit en face à face entre lesdits panneaux (58, 80 ; 58, 152, 150).

18. Ensemble d'attache et de panneaux selon l'une quelconque des revendications précédentes 14 à 17, dans lequel ladite rainure annulaire de partie de rebord (40) comprend une pluralité de nervures radiales (42) et ledit premier panneau (58) est déformé dans ladite rainure en forme de V de ladite partie de rebord (24) autour desdites nervures radiales (42), ce qui empêche une rotation de ladite attache relativement auxdits panneaux (58, 80 ; 58, 152, 150).

19. Ensemble d'attache et de panneaux selon l'une quelconque des revendications 14 à 18, caractérisé en ce qu'une surface externe de ladite partie de cylindre (22) espacée de ladite extrémité libre est déformée radialement vers l'extérieur pour former une nervure annulaire radiale (76) portant contre ledit premier panneau (58), ce qui retient ledit premier panneau (58) dans ladite rainure de rebord (40).

20. Ensemble d'attache et de panneaux selon l'une quelconque des revendications 14 à 19, caractérisé en ce que ladite partie de cylindre (22) comprend une première partie adjacente à ladite partie de rebord présentant un diamètre extérieur (34) supérieur à une deuxième partie de cylindre adjacente à ladite extrémité libre (28).

21. Ensemble d'attache et de panneaux selon l'une quelconque des revendications 14 à 20, caractérisé en ce que ladite extrémité libre de partie de cylindre (28) est déformée radialement vers l'extérieur en une forme de crochet arqué sur un bord dudit deuxième panneau (80 ; 152, 150) entourant ladite deuxième ouverture de panneau et ledit deuxième panneau est déformé radialement vers l'intérieur contre ladite partie de cylindre (22), ce qui forme un contact d'accouplement intime entre ledit deuxième panneau (80 ; 152, 150) et ladite partie de cylindre (22).

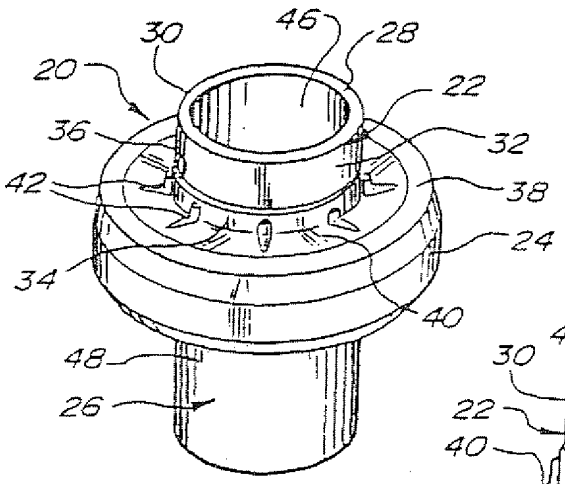


Fig-1

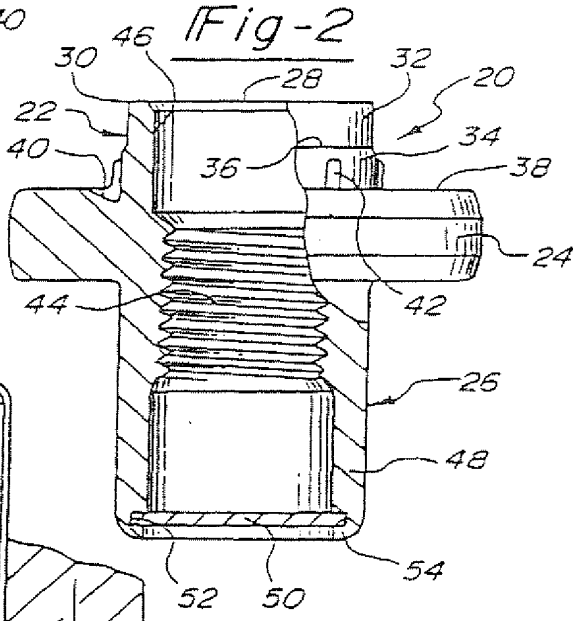


Fig-2

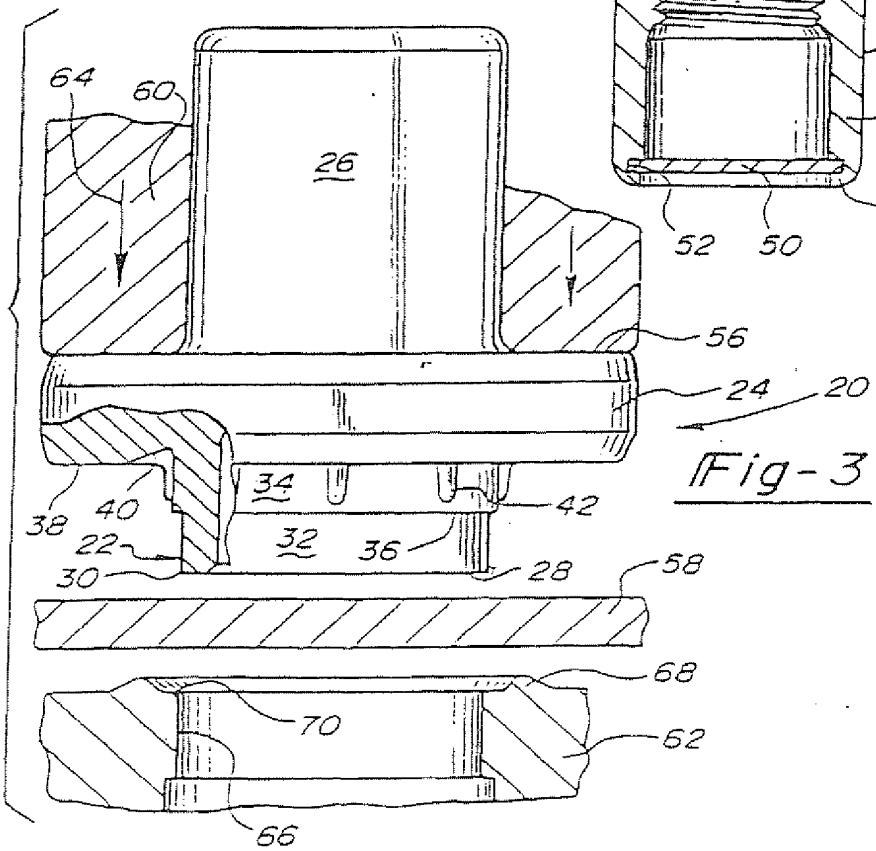


Fig-3

Fig-4

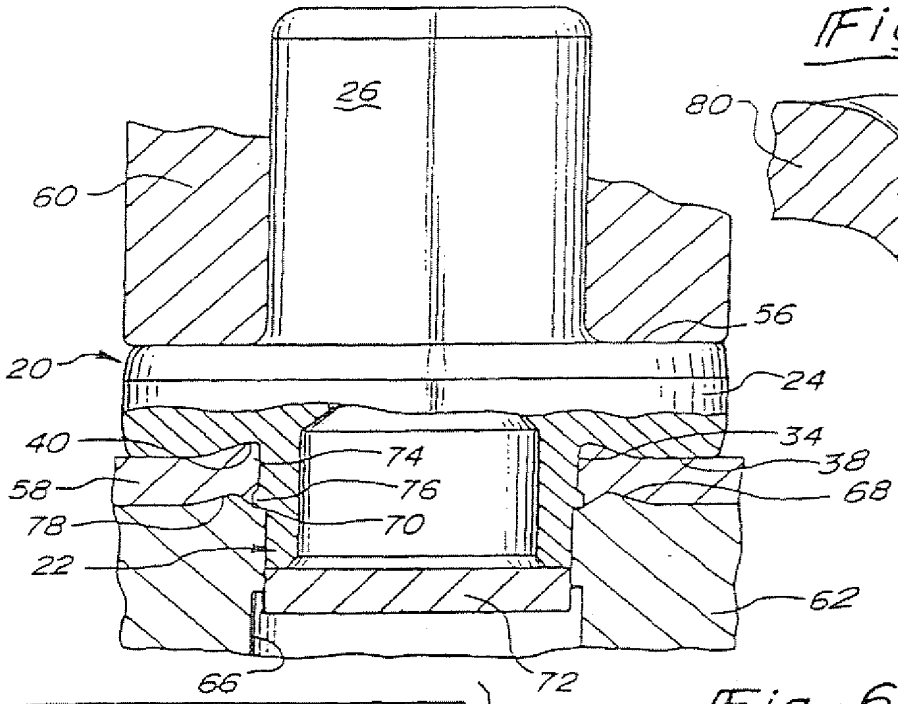
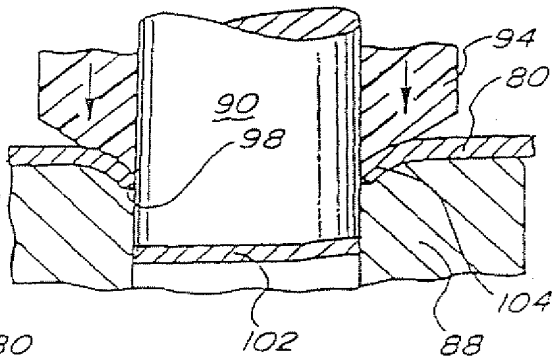


Fig-7

Fig-6



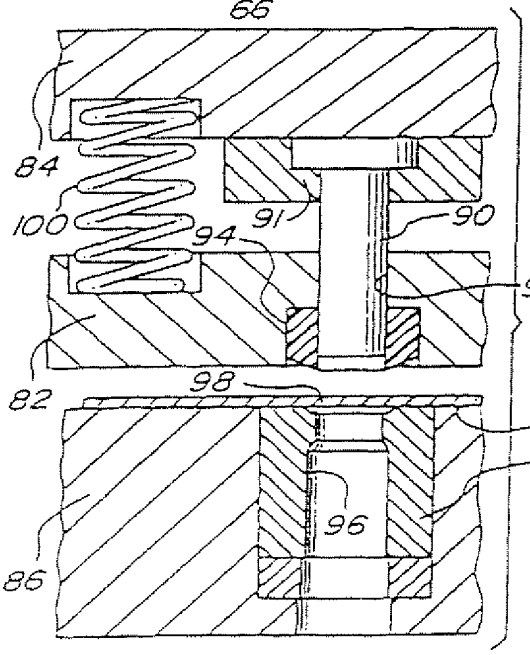


Fig-5

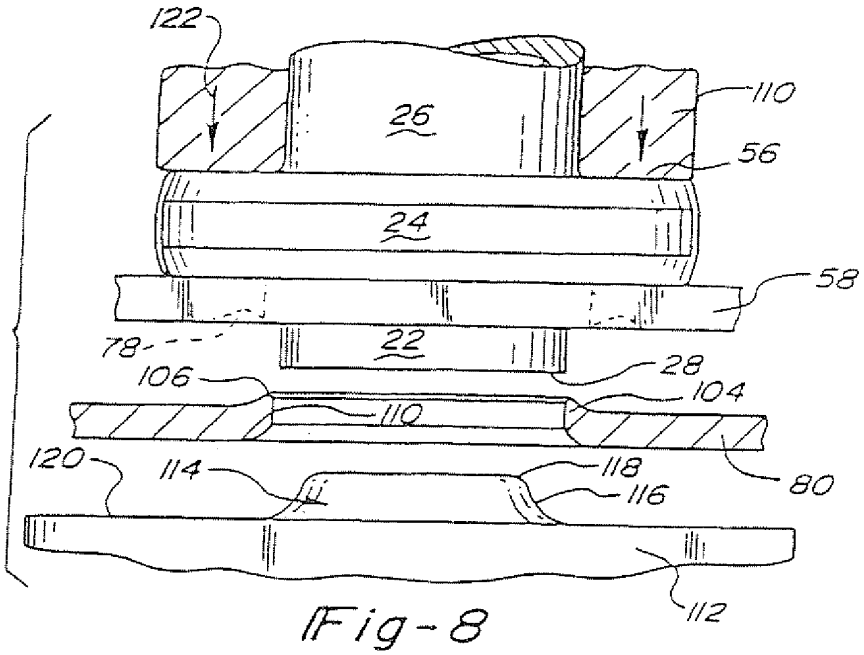

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Fig-8

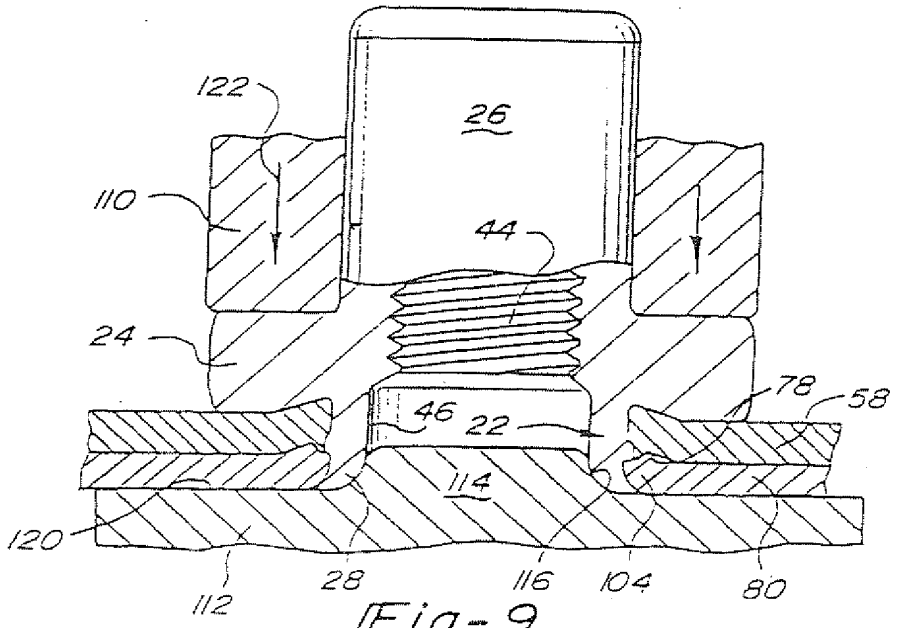
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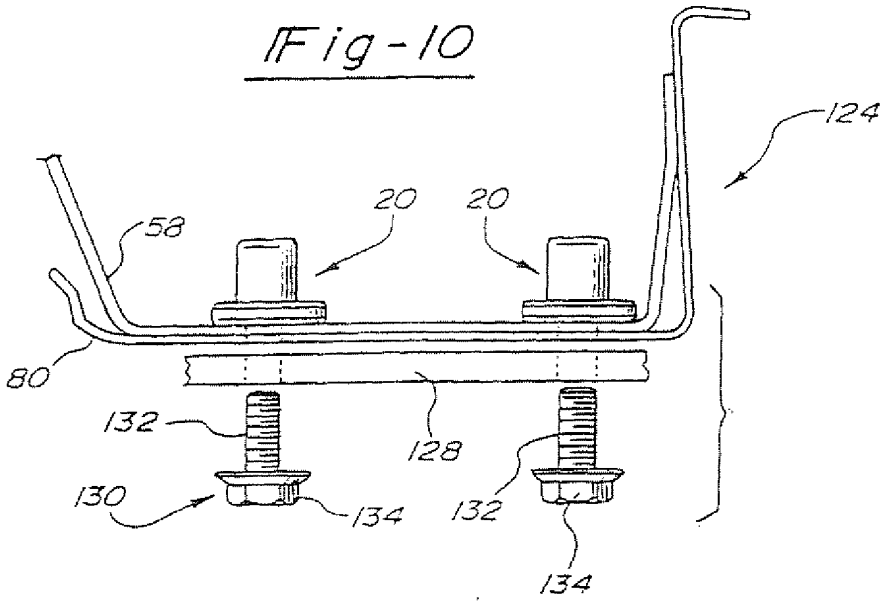
Fig-9

Fig-10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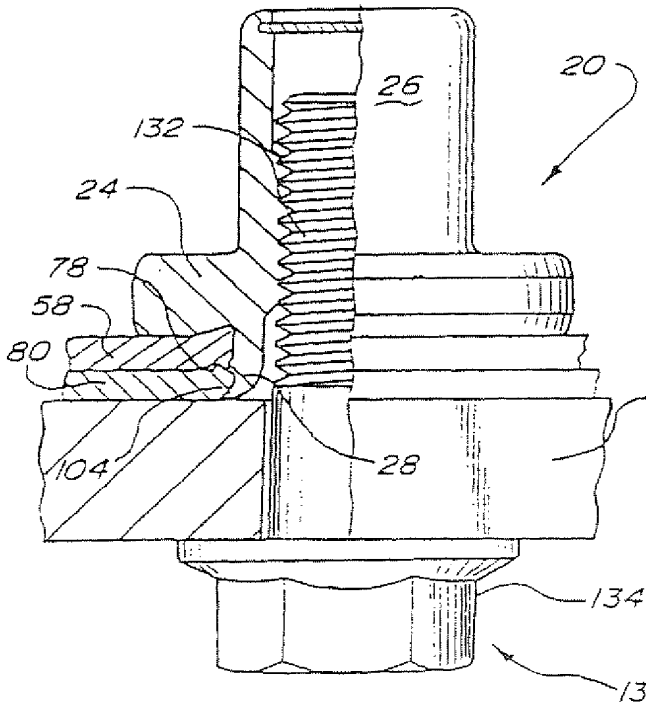
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Fig-11

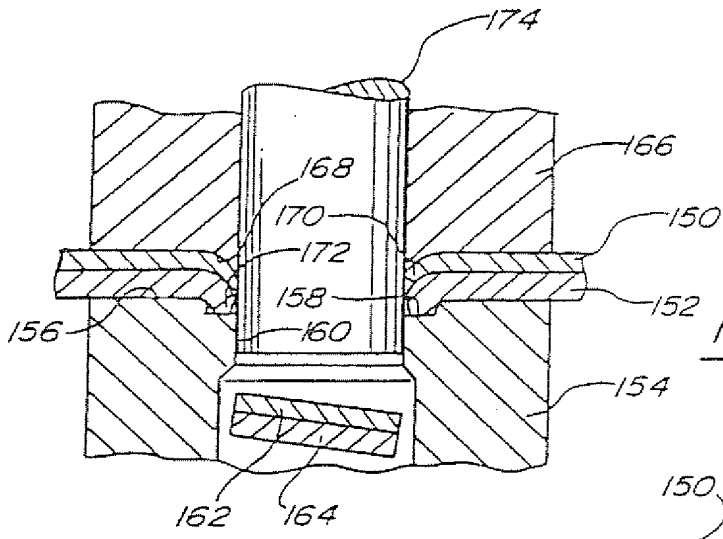

Fig-12

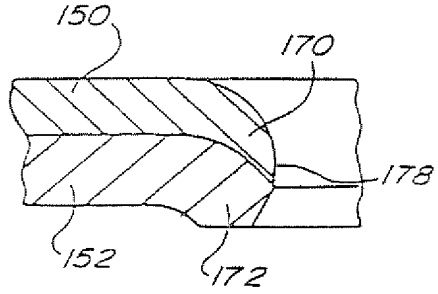

Fig-13

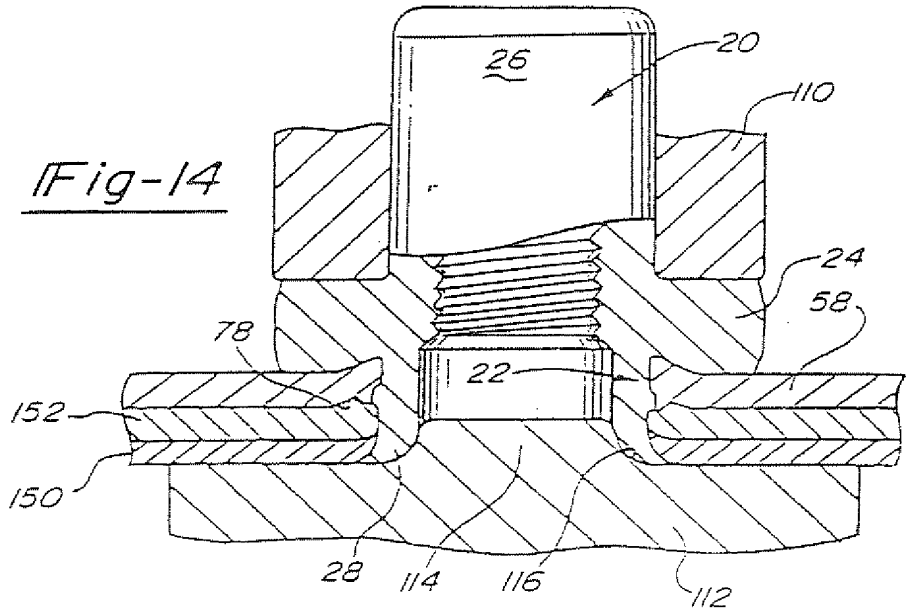

Fig-14

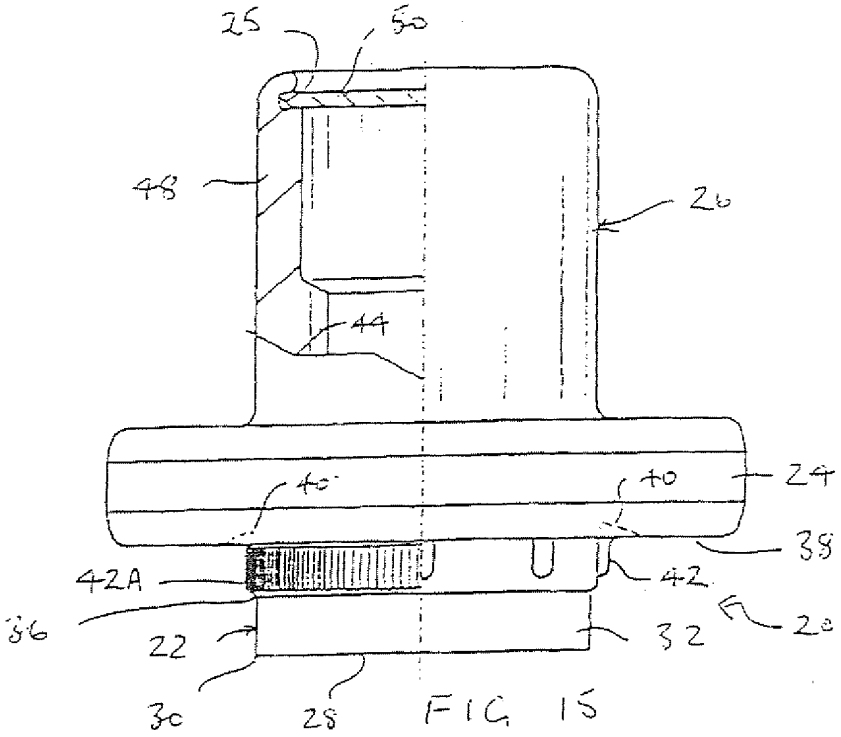

FIG 15